Great Lakes Binational Toxics Strategy

Draft Report for

BENZO(A)PYRENE (B(A)P): SOURCES AND REGULATIONS

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1.0 INTRODUCTION

On April 7, 1997, Canada and the United States signed the *Great Lakes Binational Toxics Strategy: Canada-United States Strategy for the Virtual Elimination of Persistent Toxic Substances in the Great Lakes* (Binational Toxics Strategy or BNS). The Binational Toxics Strategy identified twelve bioaccumulative substances having sufficient toxicity and presence in water, sediments and/or aquatic biota of the Great Lakes system to warrant concerted action to eliminate their input to the Great Lakes. They are called "Level 1 substances". Benzo(a)pyrene (B(a)P) is one of the Level 1 substances. B(a)P is the subject of this report, which is in response to the "Challenge" written in the BNS:

> *Seek, by 2006, reductions in releases that are within, or have the potential to enter the Great Lakes Basin, of B(a)P from sources resulting from human activity.*

To guide Environment Canada (EC) and the United States Environmental Protection Agency (USEPA), along with their partners, as they work toward virtual elimination of the strategy substances, the BNS outlined a four-step analytical framework:

1. Information gathering

2. Analyze current regulations, initiatives, and programs which manage or control substances

3. Identify cost-effective options to achieve further reductions

4. Implement actions to work toward the goal of virtual elimination

This report documents the analysis associated with Steps 1 and 2 of the four-step process for B(a)P. Step 1 encompasses identifying all sources, both within and outside the Great Lakes Basin, by economic sector, that contribute to loadings in the Basin. Step 1 also requires consideration of how the substance is used or released, its lifecycle, multi-media loadings, and associated impacts. Step 2 involves assessing existing regulations and programs and how they influence the presence of B(a)P in the Great Lakes Basin and long-range transport from other areas into the Basin. Both Steps 1 and 2 involve identifying gaps: information gaps as to sources, loadings, and impacts, and regulatory or programs gaps where there is opportunity to achieve greater reductions in substance releases.

Section 2 of this report discusses B(a)P in the environment, its impact, and effects on human health. Section 3 describes the sources of B(a)P and the available data sources in the Great Lakes states that characterize releases of B(a)P. Regulations controlling sources of B(a)P are outlined in Section 4, and non-regulatory programs aimed at reducing B(a)P releases are described in Section 5. Conclusions are provided in Section 6.

2.0 ENVIRONMENTAL AND HEALTH CONCERNS

2.1 DESCRIPTION OF B(a)P

Benzo(a)pyrene [B(a)P, CAS number 50-32-8] is a member of a class of compounds known as polycyclic aromatic hydrocarbons (PAHs). PAHs generally occur as complex mixtures and not as single compounds. Thus, B(a)P emissions are not typically reported alone but are often reported with a class of PAHs.

B(a)P is not manufactured or used commercially. It is primarily a by-product of incomplete combustion but also occurs naturally in petroleum-based tars. B(a)P is formed when gasoline, carbon-based waste, animal, or plant material burns. Because of its lower vapor pressure, it is found largely on the soot (particulate matter), rather than in the vapor phase, of combustion emissions. B(a)P is also found in coal tar pitch and creosote, both of which are used as chemical wood preservatives. B(a)P is a solid with limited solubility in water.

2.2 ENVIRONMENTAL IMPACTS AND LOADINGS

B(a)P release to the environment is quite widespread since it is an ubiquitous product of incomplete combustion. It enters the air through natural combustion processes, including forest fires and volcanic eruptions, and is emitted to air in vehicle exhaust, coke oven emissions, and contemporary fossil fuel combustion releases. It is found primarily in condensed media such as air particulate matter, soils, and sediments due to its low volatility, low water solubility, and adsorption capability. Its presence in places distant from primary sources indicates that it is quite stable in the atmosphere and undergoes long range transport.

Urban runoff and industrial effluents also have elevated levels of B(a)P. B(a)P in crude oil and in refined petroleum products (e.g., gasoline, kerosene, diesel fuel, motor oil) is suspected of contributing to watershed contamination from inadvertent leaks and spills, and from combustion exhausts of these petroleum products that condense on particles and deposit on roadways without significant airborne transport.

Cooked and uncooked foods generally contain some level of B(a)P, depending on the source of the food and the method of cooking. Fruits and vegetables grown near sources of B(a)P have higher concentrations than those grown in pristine areas. Cropland soils may be contaminated by the application of sewage sludge containing B(a)P. Charcoal broiling and smoking increase B(a)P levels in meat. B(a)P can also accumulate in fish, shellfish, and other aquatic organisms. B(a)P in contaminated Great Lakes sediments has been reported to accumulate in bottom-dwelling invertebrates and fish (ATSDR, 1999).

2.3 EXPOSURE AND HEALTH EFFECTS

Non-occupational human exposure to B(a)P occurs mainly through cigarette smoking, inhalation of environmental tobacco smoke (second-hand smoke), and through the consumption of food, especially meats and fish that have been smoked or charcoal-broiled. Indoor residential

inhalation exposure to B(a)P also occurs as a result of using wood fireplaces and wood-stoves, coal and oil furnaces, and kerosene heaters. High levels of occupational exposure via inhalation or dermal contact can occur in coal-tar-production plants, coking plants, petroleum refineries, smoke houses, trash incinerators, asphalt-production plants, or other facilities that burn wood, coal, or oil. Occupational exposure to B(a)P may also occur in road sealing and roofing work involving coal tar and asphalt, and in areas where high-temperature food fryers and broilers are in use. Exposure to B(a)P also occurs for workers, vehicle occupants, or pedestrians via inhalation of diesel and gasoline engine exhaust, and for residents living near industrial sources of B(a)P (e.g., coke plants).

B(a)P is considered a probable human carcinogen for long-term and/or high exposures. Animal studies also suggest developmental and reproductive problems with long-term B(a)P exposure. Short-term health effects may include red blood cell damage, suppression of the immune system, and anemia.

2.4 SENSITIVE SUBPOPULATIONS AND GEOGRAPHIC REGIONS

Exposure to B(a)P is expected to be highest among occupationally exposed workers. This includes workers exposed in aluminum plants, coke plants, graphite plants, creosote wood treatment plants, those involved in the cleanup of coal-tar-contaminated dump sites, and those involved in petroleum coking, road surfacing, or the use of small two-cycle gasoline engines. Individuals working extensively with roofing materials, asphalt, and coal tar may also incur higher exposures. Other highly exposed populations include cigarette smokers and nonsmokers living or working in close proximity to smokers. For the average non-smoker, the predominant source of B(a)P exposure is dietary (ATSDR, 1999).

Members of the general population who heat their homes with coal-, oil-, wood-, or kerosene-burning stoves, tribes and rural populations whose predominant method of trash disposal is open burning, residents in the vicinity of emission sources (e.g., high density traffic), individuals using products containing PAHs (e.g., coal-tar containing psoriasis medication), and people living in the vicinity of National Priority Listed (NPL) sites where PAHs have been detected above background levels are expected to experience higher exposures than the general population. Consumption of Great Lakes fish is not expected to contribute significantly to dietary exposure unless the fish is smoked or appreciably high amounts of fish from local contaminated water bodies are consumed. Fish consumption advisories had been issued as of September, 1993, for PAHs in the Hersey River in Michigan and the Black River, Little Scioto River, and the Mahoning River in Ohio (ATSDR, 1999).

3.0 SOURCES OF B(a)P

An inventory of B(a)P emissions in the Great Lakes Basin has been compiled as result of the Great Lakes Regional Air Toxic Emissions Inventory Project. This project is an ongoing initiative to provide basinwide data on source and emission levels of 49 toxic contaminants from the best available data for point and area sources in the Great Lakes Basin. Beginning with a

report released in 1998 using 1993 data, the Regional Air Toxic Emissions Inventory is expected to be updated every year.

At present, there is no national emissions inventory for B(a)P. Rather, B(a)P has been grouped with a class of similar compounds known as polycyclic aromatic hydrocarbons or PAHs. As PAHs are regulated under the Clean Air Act, a national emissions inventory, USEPA's *1990 Emissions Inventory of Section 112(c)(6) Pollutants*, has been developed for a class of 7 PAHs of similar molecular weight and carcinogenicity. The inventory for this class of 7 PAHs, which includes B(a)P, encompasses a broader range of source categories than the Great Lakes inventory. Updates to USEPA's national emissions inventory, the 1993 and 1996 National Toxics Inventories, are scheduled to be released before the end of 1999. The source categories reported for B(a)P in the Great Lakes inventory, as well as additional source categories identified for 7 PAHs in USEPA's *1990 Emissions Inventory of Section 112(c)(6) Pollutants*, are described below.

3.1 AIR EMISSIONS

Emissions of B(a)P were compiled in the *Great Lakes Regional Air Toxics Emissions Inventory Report* (EPA, 1998) from five Great Lakes states using 1993 data. Total airborne emissions of B(a)P to the Great Lakes Basin were estimated to be approximately 121,563 pounds (61 tons). Figure 1 presents a breakdown of the 1993 estimated B(a)P emissions by source category for the Great Lakes basin.

Residential Wood Combustion

According to estimates available from the *Great Lakes Regional Air Toxics Emissions Inventory Report*, residential wood combustion accounts for the largest percentage (45.8%) of B(a)P emissions in the Great Lakes basin. This category includes wood burned in fireplaces and wood-burning devices such as wood stoves, furnaces, and fireplace inserts.

Emissions from wood-stoves are more of a concern than fireplace emissions due to the greater frequency of wood-stove use. Whereas fireplaces are typically used only a half-dozen times a year, wood-stoves may be used daily as the main source of heat for a home (Van Buren, 1999). Wood-stoves built after 1990 are required by EPA to be clean burning (see Section 4.0). However, the life of a wood-stove is very long, and the majority of wood-stoves in use are the older "non-EPA certified" devices. Of the 9.3 million wood-stoves in the U.S., approximately 10%, 1 million, are EPA-certified (Houck et al., 1999).

In addition to the type of wood-burning device, wood-burning practices affect the efficiency of combustion. Smoldering combustion emits a more toxic mix and higher levels of pollutants than oxygen-rich combustion. To some extent, smoldering combustion can be avoided through proper wood-burning techniques, such as the use of fully seasoned, dry wood.

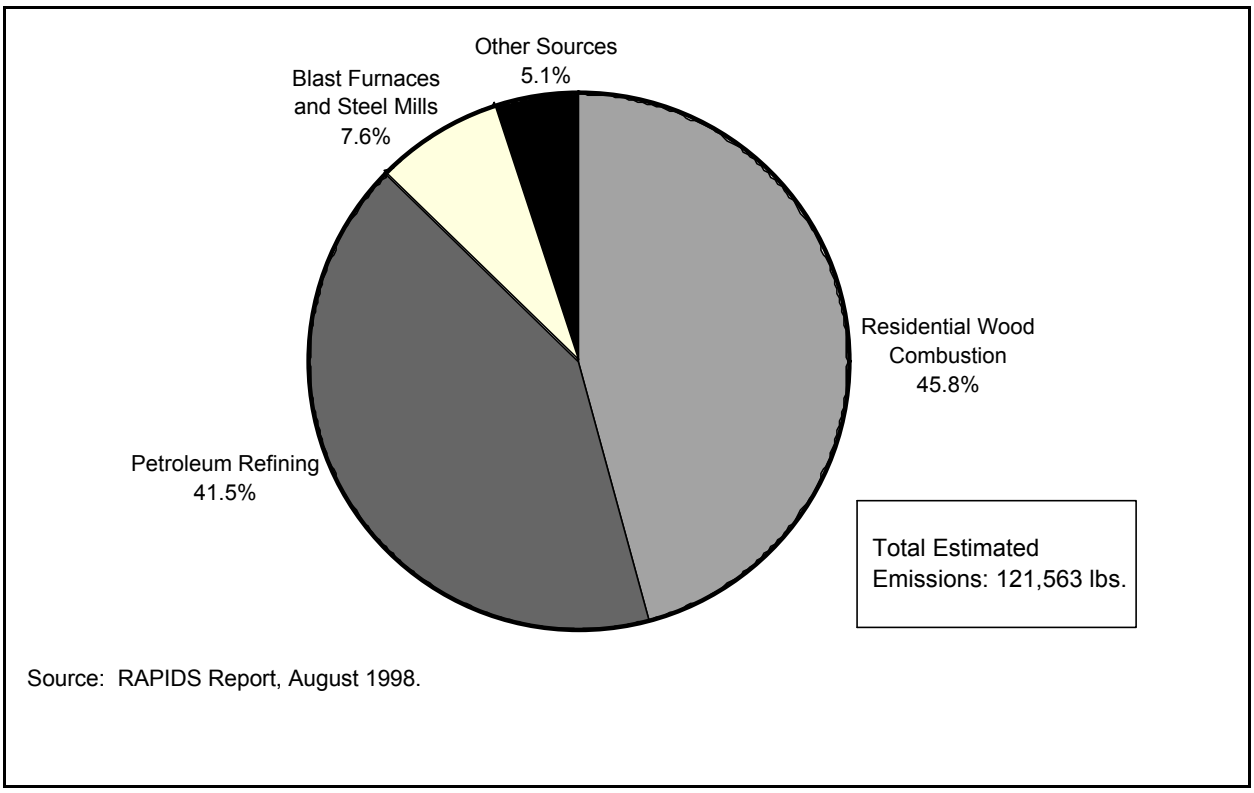

Figure 1. 1993 Great Lakes Estimated B(a)P Emissions by Source Category

Petroleum Refining

The catalytic cracking units at petroleum refineries have been identified as a source of B(a)P. Catalytic cracking is a process in which heavier weight, higher boiling hydrocarbons such as gas oil are broken down by heat in the presence of a catalyst to lighter weight, lower boiling, higher value hydrocarbons such as gasoline blend stocks and heating fuels. Fluidized-bed catalytic cracking units (FCCUs) are predominantly used by petroleum refineries for catalytic cracking.

Each FCCU operation is customized on the basis of refinery specific process, feedstock, and product mix requirements. In general, catalyst and feedstock are introduced to the reactor through a vertical tube leading to the reactor, the feedstock undergoes a cracking reaction, and some reaction products are deposited on the catalyst. As the mixture of catalyst and products enter the reactor vessel, steam is injected to strip products from the catalyst. With use, the catalyst in an FCCU loses activity, and coke and some metals remain deposited on the catalyst. To restore catalyst activity, the used or spent catalyst is routed continuously from the reactor to a regenerator vessel and the catalyst activity is restored substantially by burning off the coke in a controlled combustion reaction. Burning the coke also provides process heat necessary for FCCU operation. The source of emissions from FCCUs is the regenerator flue gas stream.

There are two basic types of FCCU regenerators: complete burn combustion regenerators and partial burn combustion regenerators. In partial burn combustion regenerators, the controlled burn involves addition of less than stoichiometric amounts of air, so that carbon monoxide rather than carbon dioxide is generated. Since B(a)P is a product of incomplete combustion, B(a)P emissions can be expected from partial combustion units. In complete burn combustion (also called high temperature) regenerators, the regenerator is operated with a slight excess of oxygen (1 to 2 percent) to ensure complete combustion of the coke to carbon dioxide (63 FR 48889-48924). Most FCCU facilities use the complete burn method for the economic advantage of the heat recovered. Few partial combustion units are in operation. Some evidence exists, though, to suggest that a few units designed for complete combustion may not fully combust all the time (Coburn, 1999).

Coke Ovens

Blast furnaces and steel mills produce coke in coke oven batteries. Emission points in the coking process are associated with charging, pushing and quenching operations. Fugitive emissions occur at doors, charging lids, and oven offtakes; stack emissions occur at the battery stacks. The emissions are primarily fugitive emissions and are highly dependent on the maintenance of the coke ovens and worker practice. The emission rates for doors are dependent on how well the seals around the doors are maintained. The emissions from lids and offtakes are dependent on worker practice in applying sealants around the gaps, the size of the gaps, and pressure fluctuations around the coke oven. Charging emission rates are a function of the time over which the coal is loaded into the oven, the pressure fluctuations around the oven, and the gap size around the charging ports.

There are 17 coke oven plants in operation in the Great Lakes region. They are located in the Chicago area, and in Ohio, New York, and Pennsylvania.

Other Sources

The category of "Other Sources" in the 1998 Great Lakes Regional Air Toxics Emissions Inventory Report did not specify source categories but indicated that individually they represented less than five percent of the total. Other sources of B(a)P identified from additional references are described below.

Open Barrel Trash Burning

B(a)P was detected in an emissions characterization study undertaken by EPA to quantify emissions from the simulated burning of household waste material in barrels (EPA, 1997). An emission factor was developed for B(a)P in units of pounds emitted per ton of waste burned, but no estimate of emissions from open trash burning was made. Open trash burning is thought to be a common practice in many rural townships and tribal communities of the Great Lakes. It is estimated that 95 percent of some 578 tribes in the U.S. practice open burning as a means of reducing volumes of garbage (Cummings, 1999).

Meat Charbroiling

Commercial meat charbroiling was identified as source of B(a)P emissions by Rogge (1991). Although no estimates of B(a)P emissions from meat charbroilers have been made, numerous eating establishments preparing food by this method exist in the Great Lakes Basin. Residential charbroiling (i.e., charcoal and gas grilling) also contributes to B(a)P emissions, but these activities are expected to contribute more to personal exposure than to regional air levels.

Sources Identified from 1990 Emissions Inventory of Section 112(c)(6) Pollutants

USEPA's *1990 Emissions Inventory of Section 112(c)(6) Pollutants* lists B(a)P in a class of seven PAHs of similar molecular weight and carcinogenicity (EPA, 1998a). In this inventory, as in the Great Lakes inventory, residential wood combustion comprises a large percentage of emissions (29%). However, wildfires and prescribed burning are reported to account for 48% of national emissions. Primary aluminum production, coke oven charging topside and door leaks, and open burning of scrap tires account for 7%, 4%, and 3% of emissions, respectively. Source categories representing less than 2% of total emissions in this inventory are commercial coal combustion, on-road vehicles, residential coal combustion, non-road vehicles and equipment, and petroleum refining. The remaining sources individually account for less than 0.2% of total national emissions. Emissions estimates for the 7 PAH category from USEPA's *1990 Emissions Inventory of Section 112(c)(6) Pollutants* are provided in Appendix A.

Wildfires and prescribed burning are reported to account for roughly half of 1990 national 7 PAH emissions. Each year, wildfires caused by human carelessness or accidents damage millions of acres of public and private lands and natural resources. Wildfires on federal lands are managed by the Forest Service, within the Department of Agriculture, and the Bureau of Land Management, within the Department of the Interior. State and local firefighting organizations respond to wildfires on state and private lands. Various agreements among federal, state, and local firefighting organizations allow for cooperative efforts in providing mutual support in the suppression of wildfires. Prescribed, or controlled burns, may be used to recycle nutrients, reestablish native plant and animal communities, or to reduce the fuel available for dangerous wildfires to ignite.

Six processes involved in producing primary aluminum are associated with B(a)P emissions: horizontal stud Soderberg cells, vertical Soderberg cells, pre-bake cells, casting operations, paste production, and anode bake furnaces (EPA, 1998a). The emission factors vary for each process, and various devices may be used to control emissions.

Scrap tires are a problem in that stockpiled tires are susceptible to vandalism and lightning strikes that may cause the tires to burn for several days. It is estimated that two to three billion scrap tires are in landfills and stockpiles across the U.S. and that one scrap tire per person is generated every year (EPA, 1997a). Methods are recommended (e.g., proper storage site design) to prevent and minimize open tire fires. In addition, alternative applications that utilize scrap tires as a resource opportunity have been developed. For instance, tire-derived fuel is used

to supplement other fuels in industrial boilers and kilns, crumb rubber can be used in asphalt paving, and molded and extruded products such as brake pads can be made from ground rubber.

The exhaust from millions of on-road vehicles is deposited onto roads, highways, and parking lots each year, contributing to watershed contamination from runoff. The cumulative effect of each poorly-maintained vehicle that leaks oil or produces excessive exhaust particulate matter can be huge, particularly in high-density traffic areas. One study determined that the average American puts one quart of petroleum products on the roads each year from leaking crankcases and exhaust emissions (Martin, 1999).

3.2 WATER RELEASES

Atmospheric deposition is, in general, the main source of B(a)P to surface waters, with lesser amounts contributed by industrial effluents, municipal waste water, urban storm water runoff, road runoff, and oil spills. Among the industrial effluents contributing to B(a)P in surface waters are releases from wood treatment plants, coke ovens, and petroleum refineries. See Section 3.5 for more information on water releases from regulated facilities.

3.3 HAZARDOUS WASTES

B(a)P is listed as a hazardous waste and is regulated under the Resource Conservation and Recovery Act (RCRA). PAHs, including B(a)P, have been identified in commercial tars (e.g., asphalt) and in the RCRA wastes of several source categories, including petroleum refining,[1] creosote wood preserving, coking operations, used oil PAH residuals, aluminum production, combustion (cement kilns, boilers, energy recovery), and others.

3.4 NON-POINT AND RESERVOIR SOURCES

Long Range Transport

B(a)P released to the atmosphere may be subject to moderately long transport, depending mainly on the particle size distribution and climactic conditions, which will determine the rates of wet and dry deposition. Since combustion particles comprise much of the fine particulate matter in air, the presence of B(a)P in areas remote from primary sources demonstrates its considerable stability in air and its potential for long range transport.

[1] It should be noted that B(a)P and other PAH compounds are intrinsic in the blending processes associated with petroleum products (e.g., diesel fuels, tar, creosote, etc.) and are not residuals associated only with the combustion process.

Soil

PAHs are ubiquitous in soil, primarily due to the abundance of anthropogenic combustion processes. Generally, background soil concentrations for PAHs are highest in urban soil, followed by agricultural and rural soil, reflecting the predominance of combustion sources in urban areas. Elevated B(a)P levels have been found in soil at wood preserving and coking sites, manufactured gas plants, and hazardous waste treatment operations (ATSDR, 1999).

Eighteen sites in EPA Region 5 are currently on the EPA Superfund Program's final National Priority List (NPL) with B(a)P listed as a contaminant of concern for all media (http://www.epa.gov/superfund/ sites/index.htm). NPL sites are the most serious hazardous waste sites in the U.S. as identified by EPA's Superfund Program for long-term federal cleanup activities. The sites containing B(a)P in EPA Region 5 are listed in Appendix A.

Sediments

Sediments are major sinks for PAHs. PAHs emitted from combustion sources and from boating and shipping activities may eventually enter water bodies and accumulate in sediment. EPA's 1998 report "*The Incidence and Severity of Sediment Contamination in Surface Waters of the United States*" indicates that atmospheric deposition, industrial discharges, municipal discharges, and urban sources are all point sources contributing to PAH contamination in sediments (EPA, 1999). The report does not consider sources that are difficult to categorize as point or non-point: leaching landfills, recreational and commercial boating, and dredging of contaminated materials. In the Great Lakes, B(a)P was identified as a contaminant contributing to the classification in the report of the following sites as Tier 1 or Tier 2:[2] Ashtabula-Chagrin, Buffalo-Eighteenmile, Cedar-Portage, Chautauqua-Conneat, Lake St.Clair, Little Calumet-Galien, Lower Fox, Manistee, Niagara, Oak Orchard-Twelvemile, Ottawa-Stony, and St.Clair-Detroit. Maximum concentrations of B(a)P in sediment samples of 107 and 75 ppm were measured in the Buffalo-Eighteenmile and Chautauqua-Conneat watersheds, respectively. Both areas are in eastern Lake Erie.

The most important source of sediment contamination varies by location, and more than one source category may contribute to significant contamination. Atmospheric deposition is often identified as a primary contributor of PAHs to aquatic systems. Permit monitoring data indicate that many municipal sewage treatment plants and major industrial facilities discharge PAHs to watersheds, presenting the potential to adversely affect sediment quality. Runoff from roadways, residential and commercial areas, construction sites, and marinas and shipyards contribute to urban sources affecting sediment quality (EPA, 1999). Emissions from commercial and residential fuel-burning furnaces and vehicle emissions are additional urban sources associated with PAHs in contaminated sediment. Waterways with heavy diesel traffic have been reported to contain high levels of PAH-contaminated sediment (ATSDR, 1999).

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[2]Tier 1 sites are those where associated adverse effects are probable. Tier 2 sites are those where associated adverse effects are possible, but expected infrequently.

3.5 DATA SOURCES FOR THE GREAT LAKES STATES

As discussed in Section 3.0, an inventory of B(a)P emissions has been compiled for the Great Lakes. The states of Illinois, Indiana, Michigan, Minnesota, and Wisconsin conducted statewide air toxic emissions inventories for the Great Lakes Air Toxic Emissions Inventory Project for the calendar year 1993. Data from these state inventories were used to compile the 1993 B(a)P emissions inventory for the Great Lakes (*Great Lakes Regional Air Toxics Emissions Inventory Report* EPA, 1998).

In addition, ambient air and precipitation monitoring is conducted at several sites in the Great Lakes Basin through the Integrated Atmospheric Deposition Network (IADN) and Environment Canada ambient air monitoring.

B(a)P water releases are reported under EPA's Permit Compliance System (PCS). B(a)P releases are not reported individually to either EPA's Toxic Chemical Release Inventory (TRI) or RCRA's Biennial Reporting System (BRS) but may be reported within the category of polycyclic aromatic compounds.

Information from each of these sources is summarized below, and included in detail in Appendix A. Appendix A provides a summary of the number of facilities that report B(a)P releases under these programs. The number of facilities reporting releases varies by reporting program as a result of differing reporting requirements.

Integrated Atmospheric Deposition Network

The Integrated Atmospheric Deposition Network (IADN) was established by the U.S. and Canada for conducting air and precipitation monitoring in the Great Lakes Basin. IADN was created as part of the 1987 amendments to the Great Lakes Water Quality Agreement. Currently, the network consists of five Master Stations and 14 Satellite Stations in both Canada and the U.S. which measure wet deposition and air concentrations of gas phase and particulate phase organics and trace elements. Data comparing the wet and dry deposition, gas absorption, and gas volatilization for B(a)P showed that wet and dry deposition from the atmosphere largely defined the loading of B(a)P to Lake Ontario in 1994 (IADN, 1998). Wet and dry deposition decrease from the lower to upper lakes, being the greatest for Lake Erie. This may be enhanced by large urban sources along Lake Erie. Appendix A includes precipitation, particle phase, and gas phase concentration data from IADN Master Stations for B(a)P from 1992-1994.

Environment Canada

The Analysis and Air Quality Division of Environment Canada conducts ambient air monitoring of over 300 contaminants, including B(a)P, at locations around the country. In a 1997 unpublished report entitled "*Monitoring of Persistent Toxic Substances in Ontario–Great Lakes Basin*", a large gradient in ambient air concentrations between urban and rural sites was demonstrated for B(a)P, indicating a substantial influence from local sources of release. A maximum concentration of 16 ng/m^3 was measured at the Hamilton, Ontario, site (Dann, 1997).

RCRA Biennial Report Data

The RCRA Biennial Report System (BRS) tracks information on hazardous waste generated and managed by large quantity generators and permitted Treatment, Storage, and Disposal (TSD) facilities. There are no waste codes that specifically characterize B(a)P in hazardous waste. However, there are many waste codes characterizing the wastes resulting from industry-specific processes for source categories of B(a)P. For example, waste code “F037" defines petroleum refinery primary oil/water/solids separation sludge.

Permit Compliance System (PCS) Data

EPA's Permit Compliance System (PCS) data for water discharges approximates point source loads from municipal and industrial dischargers. The information is based on monitoring data supplied by regulated facilities. EPA uses PCS data as the basis for its National Pollutant Discharge Elimination System (NPDES) permit enforcement program. Table 1 presents PCS data by industrial sector for regulated facilities in EPA Region 5 issued permits between January 1, 1995 and August 31, 1999. These are facilities that were issued permits to discharge B(a)P. Table 1 does not imply release of B(a)P; data on actual discharges of B(a)P could not be obtained. Appendix A lists the number of facilities in Great Lakes states holding NPDES permits to discharge B(a)P from EPA's Permit Compliance System.

Table 1. Facilities in EPA Region 5 Issued NPDES Permits between 1995 and 1999 to Release B(a)P

Industrial Sector	SIC Code	Number of Permits Issued
Plastic Materials, Synthetic Resins, and Nonvulcanizable Elastomers	2821	10
Petroleum Bulk Stations and Terminals	5171	9
Railroads, Line-Haul Operating	4011	8
Gasoline Service Stations	5541	7
Nonclassifiable Establishments	9999	6
Electric Services	4911	5
Refined Petroleum	4613	4
Wood Preserving	2491	3
Steel Works, Blast Furnaces (Including Coke Ovens), and Rolling Mills	3312	3
Cyclic Crudes and Intermediates	2865	2
Industrial Organic Chemicals, nec	2869	2
Sewerage Systems	4952	2
Other	–	23

Toxic Chemical Release Inventory (TRI)

The Toxic Chemical Release Inventory (TRI) contains chemical release and transfer information from manufacturing facilities (SIC codes 20 - 39) which have ten or more employees and that manufacture or process 25,000 pounds of a listed chemical or otherwise use 10,000 pounds of a listed chemical. TRI reporting of B(a)P releases is not required under the Emergency Planning and Community Right to Know Act (EPCRA) (see Section 4.0). However, TRI does report for the larger chemical category of polycyclic aromatic compounds. No TRI releases of polycyclic aromatic compounds were reported in EPA Region 5 for 1997.

4.0 REGULATIONS AFFECTING B(A)P SOURCES

Table 2 provides an overview of B(a)P regulations under the Clean Air Act (CAA), the Clean Water Act (CWA), the Safe Drinking Water Act (SDWA), the Resource Conservation and Recovery Act (RCRA), and the Comprehensive Environmental Response, Compensation, and Liability Act (CERLA). These are described in greater detail below.

Clean Air Act

In the U.S., the Clean Air Act (CAA) establishes requirements for airborne emissions from a variety of sources. USEPA, state, and regional air quality agencies are all likely to be involved in CAA implementation. Under the CAA, the major regulatory requirements include National Emissions Standards for Hazardous Air Pollutants (NESHAPS) and maximum achievable control technology (or MACT standards) for a specific list of hazardous air pollutant source categories and subcategories. Included on this list is polycyclic organic matter, which encompasses B(a)P as a PAH. The CAA also establishes the national ambient air quality standards, which although they have no direct regulatory impact, serve as baseline for judging the effectiveness of release regulations. Currently, there is no federal ambient air standard established under the CAA for B(a)P.

To control particulate matter (PM) emissions from residential wood combustion, the largest source of B(a)P emissions in the Great Lakes, a 1988 New Source Performance Standard (NSPS) requires EPA certification for residential wood-fired heaters manufactured after 1990. The certification is based on a PM emission rate limit of 7.5 grams per hour and is expected to reduce B(a)P and PM emissions from new wood-stoves. The NSPS does not apply to fireplaces and other wood-burning devices such as masonry heaters that do not meet the definition of "affected facility" in the NSPS.

Table 2. B(a)P Regulatory Overview

B(a)P Regulatory Overview						
	CAA	**CWA**	**SDWA**	**RCRA**	**SARA / EPCRA**	**CERCLA**
Current Standards and Regulations	§112(b): POM (which includes B(a)P) is a designated HAP; Major source categories identified under §112(c)(6); MACT standards promulgated or scheduled	CWA Priority: Listed priority pollutant (40CFR 423); subject to NPDES effluent limitations under §304(b) (40CFR 122) and general pretreatment (40CFR 403)	NPDWR / MCL: 0.0002 mg/L MCL goal is zero	Subtitle C: B(a)P-containing substances are listed as hazardous toxic wastes (40CFR 261.33); subject to hazardous waste regulations (40CFR 302.4) Universal treatment standards for B(a)P levels in waste (40CFR 268.48)	§313: Releases of PAHs, including B(a)P, (by facilities with 10 or more employees and that process 25,000 lbs., or otherwise use 10,000 lbs.) must be reported to TRI (40CFR 372.65) Jan. 5, 1999 Federal Register proposed reduction of TRI reporting threshold for PAHs to 10 lbs/year (64FR 687)	§103: Spills of B(a)P >1 lb. must be reported to the National Response Center

CAA: Clean Air Act
CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act
CWA: Clean Water Act
HAP: Hazardous Air Pollutant
MCL: Maximum Contaminant Level. (Drinking water standard)
NESHAPS: National Emissions Standards for Hazardous Air Pollutants (HAPs)
NPDES: National Pollutant Discharge Elimination System
NPDWR: National Primary Drinking Water Regulations
PAH: Polycyclic Aromatic Hydrocarbons
POM: Polycyclic Organic Matter
RCRA: Resource Conservation and Recovery Act
SARA/EPCRA: Superfund Amendment Reauthorization Act / Emergency Planning and Community Right-to-know Act
SDWA: Safe Drinking Water Act
TRI: Toxic Release Inventory

For the second largest source of B(a)P emission in the Great Lakes, petroleum refining, a maximum achievable control technology (MACT) standard has been proposed for refinery catalytic cracking units, catalytic reforming units, and sulfur recovery units. The MACT will require complete combustion with demonstrated compliance for petroleum refining catalytic cracking units. Complete combustion can be expected to reduce B(a)P emissions. However, complete combustion is already required under a New Source Performance Standard (NSPS) for the industry, and refineries complying with the NSPS are considered in compliance with the proposed MACT. Under the proposed MACT, only partial combustion units and complete combustion units not currently meeting the full combustion requirements would be expected to reduce B(a)P emissions further (Coburn, 1999).

Blast furnaces and steel mills, the third largest source of B(a)P emissions in the Great Lakes, are the subject of several EPA air controls. Under the Clean Air Act (CAA), a 1993 National Emissions Standard for Hazardous Air Pollutants (NESHAP) for coke oven charging,

topside, and door leaks, is projected to decrease B(a)P emissions for coke plants operating in Great Lakes states in 1998-1999 to 597 pounds per year (Melton, 1999). A MACT standard for coke ovens, which applies to pushing, quenching, and battery stacks, is scheduled for promulgation on December 31, 1999 and is expected to reduce B(a)P emissions to 0.1-0.2 pounds per year. In addition, residual risk standards (remaining risk to the public after implementation of the MACT standard) for the entire coke oven operation are being developed under the MACT program to address remaining risks from coke ovens. The scheduled date of promulgation for residual risk standards for the coke oven industry is 2001.

MACT standards are also planned for primary aluminum production and industrial, commercial, and institutional boilers. Although B(a)P emissions are not targeted specifically by these MACT standards, lower emissions of polycyclic organic matter resulting from the MACT standards can be expected to reduce B(a)P emissions.

Clean Water Act

The Clean Water Act (CWA) regulates discharges to surface waters with the overall goal to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. To control point source discharges, the CWA established the National Pollution Discharge Elimination System (NPDES) permit program, which defines the conditions and effluent limitations under which a facility may make a discharge. The NPDES permit is the regulatory tool translating the general standards (CWA, Subchapter III) into effluent limitations and monitoring requirements applicable to specific point source polluters. Indirect discharges via municipal wastewater treatment plants or sewage treatment plants must meet pre-treatment requirements, including categorical standards developed by the EPA that apply to each industry and local standards developed by each publicly owned treatment work (POTW). Effluent guidelines regulations for both direct discharges and pre-treatment standards are generally sector specific. PAHs are regulated under the Clean Water Effluent Guidelines as a group of chemicals controlled as Total Toxic Organic for the point source categories of electroplating and metal molding and casting. Specific regulatory limitations have been defined for the point source categories of organic chemicals, plastics, and synthetic fibers; iron and steel manufacturing; and nonferrous metals manufacturing (ATSDR, 1999).

The effluent limitations guidelines for the Iron and Steel Manufacturing Point Source Category are currently under reassessment. EPA is in the process of gathering data for this rule reassessment, which is scheduled to be proposed in October 2000 (Jett, 1999).

To address the risk of contaminated runoff, NPDES storm water permits are required for any storm water discharge associated with industrial activity, a large or medium municipal storm sewer system, or a discharge which EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) was established by Congress in 1974 to protect human health from contaminants in drinking water, and to prevent contamination of existing groundwater supplies. The SDWA National Primary Drinking Water Standards define enforceable maximum contaminant levels (MCLs), in addition to non-enforceable maximum contaminant level goals (MCLGs). The maximum contaminant level for B(a)P is 0.0002 mg/L (0.2 ppb), and the maximum contaminant level goal is 0 mg/L.

RCRA Requirements

The Resource Conservation and Recovery Act (RCRA) establishes a regulatory structure for the handling, storage, treatment, and disposal of solid and hazardous wastes. Subtitle C of RCRA addresses "cradle-to-grave" requirements for hazardous waste from the point of generation to disposal. A solid waste containing B(a)P may be characterized as hazardous waste when subjected toxicity testing as stipulated in 40 CFR 261.24. If the waste is so characterized, it must be managed as a hazardous waste. As stipulated in 40 CFR 261.33, when B(a)P, as a commercial chemical product or manufacturing chemical intermediate or an off-specification commercial chemical product or a manufacturing chemical intermediate, becomes a waste, it must be managed according to Federal and/or State hazardous waste regulations. Also defined as a hazardous waste is any residue, contaminated soil, water, or other debris resulting from the cleanup of a spill, into water or on dry land, of this waste. Generators of small quantities of this waste may qualify for partial exclusion from hazardous waste regulations (40 CFR 261.5).

CERCLA Reportable Quantities

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), or Superfund, establishes a list of hazardous substances which are subject to release reporting regulations. Releases of CERCLA listed hazardous substances, if occurring in amounts exceeding a predefined “reportable quantity” (RQ), must immediately be reported to the National Response Center. Persons in charge of vessels or facilities are required to notify the National Response Center (NRC) immediately when there is a release of this designated hazardous substance in an amount equal to or greater than its reportable quantity of 10 lb (4.54 kg).

Superfund Amendment and Reauthorization Act (Emergency Planning and Community Right-to-Know Act)

The Superfund Amendment and Reauthorization Act, known as SARA Title III, or the Emergency Planning and Community Right to Know Act (EPCRA), also requires notification and reporting of hazardous substances. The key regulatory requirements of EPCRA include emergency planning and release notification, Community Right-to-Know reporting, and Toxic Release Inventory (TRI) reporting. Toxic release reporting requirements, which allow for the compilation of the national Toxic Release Inventory (TRI) database, apply to specific manufacturing facilities, which have ten or more employees, and which manufacture, process, or

use specified chemicals in amounts greater than threshold quantities. Emergency planning is required when substances on the Extremely Hazardous Substances list are present in quantities exceeding the Threshold Planning Quantities (TPQs).

Principal provisions of SARA Title III that affect B(a)P reporting are the following. All facilities in the manufacturing sector (SIC codes 20 - 39) that manufacture or process 25,000 pounds of a listed chemical or otherwise use 10,000 pounds of a listed chemical must report air, water, and land releases to TRI. TRI thresholds are based on the quantity of each substance used, processed, manufactured, or imported at any of these facilities. Beginning with the 2000 reporting year, the threshold for reporting polycyclic aromatic compounds is expected to be lowered to 10 pounds per year. The purpose of the proposed lowering of the reporting threshold is to capture a vast majority of sources that are not required to report under the current reporting threshold. The proposed rule was announced January 5, 1999 (64FR687), and a final rule is expected by the end of 1999. Reporting would begin in 2000, and the first public release of data obtained through the new TRI rule would be available in 2001.

OSHA

The Occupational Safety and Health Administration (OSHA) regulates the benzene soluble fraction of coal-tar pitch volatiles (29 CFR 1910.1002). Employers must maintain a Permissible Exposure Limit for B(a)P of 0.2 mg/m^3 (8-hour time weighted average).

Transport Methods and Regulations

No person may transport, offer, or accept a hazardous material for transportation in commerce unless that person is registered and the hazardous material is properly classed, described, packaged, marked, labeled, and in condition for shipment as required or authorized by the hazardous materials regulations (49 CFR 171.2 (7/1/96)).

State Laws

In addition to federal clean water requirements, every state also regulates water pollution within their territory. This sometimes results in a dual system of permitting, whereby each facility must obtain both a federal NPDES permit and a state discharge permit. States can gain EPA approval of the state permitting system so that the state itself administers the NPDES program. In such cases, one permit issued by the state government meets both the federal and state requirements. States have the explicit right to enact any water quality standard or limitation that is more stringent than those required by federal statute (33 U.S.C. sec.1370). Minnesota has set drinking water quality standards for PAHs. New York, Ohio and Wisconsin have set water quality standards for B(a)P (ATSDR, 1999).

The states of Indiana, Michigan, New York, and Pennsylvania have set average annual acceptable ambient air concentrations for B(a)P of 0.0006 µg/m^3, 0.0003 µg/m^3, 0.00 µg/m^3, and 0.0007 µg/m^3, respectively. Open trash burning may be regulated by state (e.g., Michigan, Minnesota) and local laws. The open burning of scrap tires is banned in nearly all states. Laws

regulating the storage, processing, hauling, and disposal of scrap tires vary by state. For example, Illinois, Minnesota, Ohio, and Wisconsin ban whole tires in landfills, and several states impose a tax per vehicle title or per new tire for scrap tire disposal.

5.0 CURRENT PROGRAMS FOR B(A)P REDUCTION

Since B(a)P occurs in a mixture of other PAHs, monitoring and reduction efforts are typically aimed at a broader group of PAHs. B(a)P has been targeted independently, however, as a Level 1 substance in the Binational Toxics Strategy and as a priority pollutant in EPA's PBT Strategy. B(a)P has also been named, along with other PAHs, in international Long-Range Transboundary Air Pollution (LRTAP) negotiations. Table 3 lists these and other current domestic and international data collection and toxic reduction efforts targeting B(a)P.

Other efforts that affect B(a)P emissions include campaigns at state and local levels, and voluntary industry initiatives. For example, 35 states have developed measures to address the problem of scrap tire fires. In Illinois, EPA has held "Tire Cleanup Days" for the public to recycle old tires at no charge. The tires are shredded at the collection site for use in tire-derived fuel. Minnesota and Wisconsin offer grants for tire processors recycling scrap tires. One commercial meat charbroiling fast-food restaurant chain is currently installing catalytic converters on charbroilers at selected chain locations. The catalytic converters decrease particulate emissions by about 88 percent and thus can be expected to reduce B(a)P emissions as well. An integrated steelmaking and processing complex in Hamilton, Ontario, has undertaken refurbishment of several coke oven batteries that will help eliminate leaks and decrease particulate emissions from coking operations.

Table 3. Current Domestic and International Efforts Targeting B(a)P

Current Domestic and International Efforts Targeting B(a)P	
Program	**Description**
National and Regional Strategies	
Binational Toxics Strategy (BNS)	The BNS challenges the U.S. to seek reductions in B(a)P releases from sources resulting from human activity by 2006. The BNS provides an established process for engaging stakeholders and seeking voluntary reduction efforts through a B(a)P Workgroup. The workgroup offers an opportunity for EPA to solicit and recognize efforts toward the virtual elimination of B(a)P in the Great Lakes. An additional challenge of the BNS is to assess atmospheric inputs of strategy substances to the Great Lakes and, if long-range sources are confirmed, to work within international frameworks to reduce releases of such substances.

Table 3. Current Domestic and International Efforts Targeting B(a)P (Continued)

Current Domestic and International Efforts Targeting B(a)P	
Program	**Description**
EPA's Agency-wide Multimedia Strategy for Priority Persistent, Bioaccumulative, and Toxic (PBT) Pollutants	Building on the BNS, the PBT Strategy seeks to reduce risks from persistent toxic substances at a national level. The PBT Strategy targets B(a)P as a Level 1 pollutant. The aim of the PBT Strategy is to respond to the cross-media issues associated with PBT pollutants by going beyond the traditional single-statute approaches in order to reduce risks to human health and the environment from existing and future exposure to PBT pollutants. The PBT national action plan for B(a)P will seek to coordinate efforts among all EPA national and regional programs as well as to collaborate with international organizations to reduce risks from current and future exposure to B(a)P.
EPA's Integrated Urban Air Toxics Strategy	EPA's Integrated Urban Air Toxics Strategy identifies polycyclic organic matter, including B(a)P, as one of 33 air toxics that present the greatest threat to public health in the largest number of urban areas. Building on its existing air toxics regulatory program, key components of the Strategy are 1) regulations addressing sources at both the national and local level, 2) initiatives to identify and address specific community risks (e.g., though pilot projects), 3) air toxics assessments (including expanded air toxics monitoring and modeling) to identify areas of concern, to prioritize efforts to reduce risks, and to track progress, and 4) education and outreach efforts to inform stakeholders about the strategy and to seek input for program design and implementation.
EPA's Contaminated Sediment Management Strategy	EPA's Contaminated Sediment Management Strategy utilizes a cross-program policy framework to promote consideration and reduction of ecological and human health risks posed by sediment contamination. The strategy advocates cross-program coordination, as well as a watershed approach, to prevent and remediate existing sediment contamination and to prevent future contamination. Actions required to manage legacy contaminated sediment sites as well as sites with existing discharges, include source control, pollution prevention, and remediation.
Lakewide Management Plans (LaMPs)	The U.S. and Canadian governments agreed to develop Lakewide Management Plans (LaMPs) for each of the five Great Lakes under Annex 2 of the 1987 Great Lakes Water Quality Agreement. The purpose of the LaMPs is to assess critical pollutants as they relate to the impairment of beneficial uses of the Great Lakes and to develop measures to restore beneficial uses where they have been impaired. B(a)P has been identified as a critical pollutant in the Lake Erie LaMP.

Table 3. Current Domestic and International Efforts Targeting B(a)P (Continued)

Current Domestic and International Efforts Targeting B(a)P	
Program	**Description**
Great Lakes Regional Air Toxic Emissions Inventory Project	The Great Lakes Regional Air Toxic Emissions Inventory Project presents a compilation of best available data for emissions from point and area sources of 49 air toxics pollutants in the Great Lakes Basin. The project began with an initial inventory report in August 1998 compiled using 1993 data. The project is a long-term U.S. federal/state and provincial effort to provide basinwide data and improve decision-making capabilities by promoting consistency in data collection and analysis, establishing standard procedures and protocols, and developing an automated emission estimation and inventory system. In the initial August 1998 report, data for B(a)P were available from five Great Lakes states.
Remedial Action Plans (RAPs)	The Great Lakes Remedial Action Plan (RAP) program originated from a 1985 recommendation made by the International Joint Commission's Great Lakes Water Quality Board and was formalized in the 1987 amendments to the GLWQA. The aim of RAPs is to restore beneficial uses in 43 Areas of Concern (AOCs) identified in the Great Lakes Basin where beneficial uses or the area's ability to support aquatic life have been impaired. Through the RAP program, Canada and the U.S. are committed to cooperating with state and provincial governments to incorporate a systematic and comprehensive ecosystem approach to address critical pollutants, to restore beneficial uses, and to ensure that the public is consulted in all actions undertaken to develop and implement RAPs for designated AOCs. PAHs contribute to impaired uses in several AOCs.
Scrap Tire Management	EPA has studied the open burning of scrap tires and reported its findings in *Air Emissions from Scrap Tire Combustion* (EPA, 1997a). In its report , EPA presents recommendations for storage site design, civilian evacuation, and fire suppression tactics to minimize potential health risks from open tire fires. The Scrap Tire Management Council (STMC) is an independent advocacy organization created by the North American tire industry that offers a seminar and guidelines for the prevention and management of scrap tire fires. The Council also provides assistance in developing and promoting the utilization of scrap tires as a resource opportunity.
Wildland Fire Prevention/Education	Teams of specialists throughout the U.S. promote local wildland fire prevention efforts by raising public awareness about fire dangers and educating thousands of citizens on how they can prevent unwanted wildland fires.

Table 3. Current Domestic and International Efforts Targeting B(a)P (Continued)

Current Domestic and International Efforts Targeting B(a)P	
Program	**Description**
Wood-stove Changeout Programs and Workshops	Organized by the Hearth Products Association in cooperation with manufacturers, distributers, and retailers of wood-burning stoves, wood-stove changeout programs offer substantial trade-in rebates on purchases of advanced technology stoves and fireplaces. Wood-burning workshops are also organized as part of changeout programs for those interested in learning how to make their wood-burning systems more effective and cleaner burning. A wood-stove changeout program was held in Ontario, and EPA and the Hearth Association are planning to sponsor two additional programs in Green Bay, Wisconsin, and Traverse City, Michigan.
International Programs	
UN ECE Convention on Long-Range Transboundary Air Pollution (LRTAP) protocol	In February 1998, under the United Nations' Economic Commission for Europe Long Range Transboundary Air Pollution (LRTAP) Convention, 43 countries completed negotiations on a regional Persistent Organic Pollutants (POPs) protocol. The LRTAP Protocol sets a framework for controlling, reducing, and eliminating discharges, emissions, and losses of persistent organic pollutants, including B(a)P. The agreement does not outline numerical emission limits, but instead member countries have agreed to control emission levels above a specified baseline year selected by each country. New stationary sources will have 2 years to reach identified emission levels and existing point sources will have 8 years to reach identified emission levels once the Convention is ratified.
Monitoring Efforts	
Integrated Atmospheric Deposition Network (IADN)	IADN is a joint monitoring network established by the U.S. and Canada in response to the Great Lakes Water Quality Agreement to address issues concerning airborne contaminants in the shared Great Lakes basin. IADN is designed to assess the magnitude and trends of atmospheric deposition of toxic substances to the Great Lakes and, where possible, to determine sources of atmospheric pollutants. Among other toxic chemicals, IADN currently monitors the atmospheric deposition of B(a)P.

Table 3. Current Domestic and International Efforts Targeting B(a)P (Continued)

Current Domestic and International Efforts Targeting B(a)P	
Program	**Description**
CAA §112(m) program, Atmospheric Deposition to Great Lakes and Coastal Waters (Great Waters Program)	The 1990 Amendments to the CAA include Section 112(m), Atmospheric Deposition to Great Lakes and Coastal Waters, to establish research, reporting, and potential regulatory requirements related to atmospheric deposition of hazardous air pollutants (HAPs) to the "Great Waters". EPA's Great Waters Program coordinates activities to address the requirements of Section 112(m). Polycyclic organic matter, which includes PAHs, is a Great Waters pollutant of concern. The "Great Waters" referred to in this program are the Great Lakes, Lake Champlain, Chesapeake Bay, and specific coastal waters designated through the National Estuary Program and the National Estuarine Research Reserve System. EPA provides biennial Great Waters Reports to Congress discussing the current scientific understanding of atmospheric deposition and the health and environmental effects of toxic pollution, as well as EPA programs to protect human health and the environment.
USEPA National Study of Chemical Residues in Fish	Study design and peer review of EPA's National Study of Chemical Residues in Fish have been completed. EPA will statistically evaluate the incidence and severity of B(a)P and other chemical residues in fish, both downstream from suspected problem areas and in background areas. EPA will work with State Departments of Health and Environmental Protection and will coordinate with state fish advisory programs. Sampling will begin in fiscal year 1999 (FY99) and conclude in Summer FY01. Study results will be available in FY02.
Children's Total Exposure to Persistent Pesticides and Other Persistent Organic Pollutants (CTEPP)	As young children are hypothesized to have greater exposures, as well as greater sensitivities, to persistent organic pollutants than older children or adults, the National Exposure Research Laboratory of EPA's Office of Research and Development (ORD) plans to conduct a three-year study investigating the exposures and risks to young children from these pollutants, including PAHs. The data, collection of which are expected to begin in late 1999 or early 2000, will be used to characterize children's exposure, understand pathways, and refine exposure models. Information on how and to what extent children are exposed to PAHs and other PBTs will be used to guide exposure reduction and environmental remediation activities and to determine what additional steps may be needed to protect young children.
National Oceanic and Atmospheric Administration (NOAA) Mussel Watch Program	The National Oceanic and Atmospheric Administration's (NOAA) Mussel Watch Project has been using measurements of contaminants in mussel and oyster tissues since 1986 to evaluate the status and trends in contaminant levels in the nation's Great Lakes, estuarine, and marine waters. Sites are visited approximately biennially for collection of animals to be analyzed for a suite of over 70 contaminants, including PAHs.

6.0 CONCLUSIONS

Status of Knowledge Concerning Sources

Data collected from the Great Lakes states of Illinois, Indiana, Michigan, Minnesota, and Wisconsin indicate that almost 90 percent of B(a)P emissions in the Great Lakes Basin originate from two source categories: 46 percent from residential wood combustion and 42 percent from petroleum refining. Coke ovens are reported to comprise approximately 8 percent; other unnamed sources are reported to account for 5 percent of B(a)P emissions in the Great Lakes Basin (EPA, 1998).

The national emissions inventory for the 7-PAH chemical category, which includes B(a)P and similar compounds, reports 21 major source categories of 7 PAHs, as well as other, smaller source categories (EPA, 1998a). Like the Great Lakes B(a)P inventory, the national inventory for 7 PAHs is dominated by two source categories. For the national inventory, however, these are wildfires and prescribed burning (48 percent) and residential wood combustion (29 percent).

The exclusion of several source categories from the Great Lakes inventory of B(a)P emissions is likely due to a lack of available emissions data from those source categories, rather than from the absence of those sources in the Great Lakes Basin. In Ohio, for example, a scrap tire fire raged for days in August 1999 before it could be extinguished, sending large plumes of black smoke into the air. Source categories not listed in the Great Lakes inventory but which may be contributing to B(a)P emissions in the basin include primary aluminum production, open burning of scrap tires, coal combustion, and on- and off-road vehicles and equipment. Commercial meat charbroiling and open trash burning are additional emission sources not listed in either the Great Lakes inventory or the national 7-PAH emissions inventory but which are reported in the literature (Rogge, 1991; EPA, 1997). Emissions estimates for commercial meat charbroiling and open trash burning have not been developed.

The Great Lakes inventory estimates that airborne emissions of B(a)P to the Great Lakes Basin are approximately 122,000 pounds (61 tons), and PAHs have been identified in the wastes of several industrial processes. Atmospheric deposition of B(a)P released to air is the main source of B(a)P to surface waters and may be a primary contributor to sediments in aquatic systems. B(a)P in the atmosphere is also capable of long-range transport. To the extent that air emissions and the generation of wastes can be controlled, surface water contamination, deposition to sediment, and long-range transport might also be reduced.

Regulations and Regulatory Gaps

While regulations will provide significant control over most industrial point sources of B(a)P emissions, control of many area sources is limited. Petroleum refineries, coke ovens, primary aluminum plants, and commercial and industrial boilers will be affected by MACT standards that may be expected to lower B(a)P emissions. Enforcement and compliance of regulations to control emissions from residential wood-burning, wildfires, scrap tire fires, open

trash burning, and residential coal and oil combustion are not as easily accomplished and may require innovative approaches, including education, incentives, and voluntary actions.

As of 1990, newly manufactured wood-fired heaters are required to meet an EPA certification for particulate matter (PM) emissions. Although this standard has been in effect for nearly ten years, only about 11 percent of wood-stoves in the U.S. are EPA-certified. The phase-out of older wood-fired heaters that do not meet EPA's PM limit is slow to take effect. Industry associations, such as the Hearth Products Association, are taking measures to accelerate the replacement of older wood-stoves, as well as to provide education on clean burning techniques that result in lower PM emissions.

There are many issues associated with wildfire control and prevention. Education and awareness may be keys to preventing unwanted fires caused by a lack of understanding about fire conditions and fire causes. The maintenance of qualified and adequate resources to fight fires and the cooperation of federal, state, and local organizations are needed to ensure the success of firefighting efforts in controlling emissions from wildfires.

Although several states have implemented scrap tire management programs in recent years, scrap tire fires continue to occur as a result of lighting strikes and vandalism. In addition, scrap tires in some landfills and stockpiles have not been cleaned up or appropriately managed to prevent or minimize fires. The development of opportunities to recycle old tires and permits to combust products derived from used tires also reduce the number of scrap tire piles and therefore lessen the chance of unwanted fires.

Regulations concerning open trash burning vary by state and locality, as does enforcement. Although the extent of open trash burning in the Great Lakes is not known, the practice may be more prevalent in rural areas and tribal communities where trash collection and recycling opportunities may not be as readily available as in urban areas.

In conclusion, three source categories of B(a)P air emissions in the Great Lakes Basin have been identified from an inventory compiled with data from five of the eight Great Lakes states. Additional source categories have been identified in a national emissions inventory for 7 PAHs. Whereas regulations may adequately control known industrial point sources of B(a)P emissions, sources of area emissions prove more difficult to control.

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APPENDIX A

Appendix A contains information on B(a)P releases available from several federal and state reporting systems. Federal and state agencies collect information on B(a)P releases as part of broader programs designed to meet reporting requirements for multiple substances. It is important to keep in mind that each data set must be interpreted separately due to differences in reporting requirements and the types of information collected. Table A1 presents B(a)P concentration data from Integrated Atmospheric Deposition Network (IADN) master stations for 1992-1994. Table A2 presents the number of facilities in Great Lakes states holding National Pollutant Discharge Elimination System (NPDES) permits to discharge B(a)P, from EPA's Permit Compliance System (PCS). Table A3 lists the 1990 7-PAH Clean Air Act (CAA) Section 112(c)(6) emissions estimates by source category. Table A4 lists the sites in EPA Region 5 currently on the Final National Priority List (NPL) with B(a)P as a contaminant of concern.

Table A1. B(a)P Concentration Data from IADN Master Stations 1992-1994 Annual Averages

Year	Superior			Michigan			Huron			Erie			Ontario		
	Precip (ng/L)	Particle (pg/m3)	Gas (pg/m3)	Precip (ng/L)	Particle (pg/m3)	Gas (pg/m3)	Precip (ng/L)	Particle (pg/m3)	Gas (pg/m3)	Precip (ng/L)	Particle (pg/m3)	Gas (pg/m3)	Precip (ng/L)	Particle (pg/m3)	Gas (pg/m3)
1992	2.90	11.0	9.30	3.80	21.0	10.4	NA	NA	NA	5.10	44.0	13.0	3.00	45.0	3.00
1993	1.45	2.38	8.90	1.81	8.88	9.10	NA	28.1	NA	5.04	35.9	9.20	NA	54.2	NA
1994	2.90	11.0	9.30	3.80	21.0	10.4	NA	14.3	NA	5.10	44.0	13.0	NA	36.0	NA

Table A2. Number of Facilities in Great Lakes States Holding NPDES Permits to Discharge B(a)P, from PCS

Number of Facilities Reporting								
IL	IN	MI	MN	NY	OH	PA	WI	Total
59	5	8	2	-	7	-	3	**84**

Data is the most current available: 1995-1999.

Table A3. 1990 7 PAH CAA Section 112(c)(6) Emissions Estimates by Source Category

	Source Category	Percent of Total 7-PAH Emissions	7-PAH Emissions (lbs/yr)
1	Wildfires and prescribed burning	48.30%	1,928,000
2	Residential wood combustion	28.66%	1,144,000
3	Primary aluminum production	7.06%	282,000
4	Coke ovens: charging, topside & door leaks	3.60%	143,600
5	Open burning of scrap tires	2.63%	105,000
6	Commercial coal combustion	1.80%	72,000
7	Onroad vehicles	1.73%	68,800
8	Residential coal combustion	1.60%	63,800
9	Coke ovens: pushing, quenching & battery stacks	1.58%	60,200
10	Non-road vehicles & equipment - other(1)	1.20%	48,000
11	Petroleum refining: all processes	0.82%	32,800
12	Pulp & paper manufacturing - Kraft recovery furnaces	0.19%	7,480
13	Industrial coal combustion	0.15%	6,180
14	Portland cement manufacture: non-hazardous waste kilns	0.13%	5,200
15	Other sources(2)	0.11%	4,391
16	Portland cement manufacture: hazardous waste kilns	0.10%	4,160
17	Residential oil combustion	0.09%	3,400
18	Asphalt roofing production	0.08%	3,360
19	Industrial waste oil combustion	0.07%	2,680
20	Industrial wood/wood residue combustion	0.06%	2,420
21	Industrial stationary IC engines - natural gas	0.05%	2,060
22	Commercial wood/wood residue combustion	0.05%	2,020
	TOTAL		**3,991,600 lbs/yr**

(1) Includes 74 different equipment types, such as agricultural, construction, and industrial equipment and vehicles.

(2) “Other sources" includes: Asphalt hot-mix production, carbon black production, cigarette smoke, commercial oil combustion, crematories, drum and barrel reclamation, ferroalloy manufacture, hazardous waste incineration, industrial oil combustion, industrial stationary engines - diesel, iron foundries, landfill (gas) flares, pulp & paper manufacturing - lime kilns, residential natural gas combustion, scrap tire incineration, secondary lead smelting, sewage sludge incineration, and utility oil combustion.

(3) These refer to EPA air programs that target the emissions source category listed. They may or may not directly affect PAH emissions.

Table A4. Sites Within EPA Region 5 Currently on the Final NPL (Superfund) with B(a)P Detected as One Contaminant of Concern

	Site Name	City	State
1	Allied Chemical & Ironton Coke	Ironton	Ohio
2	Continental Steel Corp.	Kokomo	Indiana
3	Douglass Road/Uniroyal, Inc., Landfill	Mishawaka	Indiana
4	Electrovoice	Buchanan	Michigan
5	Feed Materials Production Center (USDOE)	Fernald	Ohio
6	H. Brown Co., Inc.	Grand Rapids	Michigan
7	Lower Ecorse Creek Dump	Wyandotte	Michigan
8	Mound Plant (USDOE)	Miamisburg	Ohio
9	Ormet Corp.	Hannibal	Ohio
10	Parsons Casket Hardware Co.	Belvidere	Illinois
11	Reilly Tar & Chemical (Indianapolis Plant)	Indianapolis	Indiana
12	Rockwell International Corp. (Allegan)	Allegan	Michigan
13	Sanitary Landfill Co. (Industrial Waste)	Dayton	Ohio
14	Skinner Landfill	West Chester	Ohio
15	Sturgis Municipal Wells	Sturgis	Michigan
16	Van Dale Junkyard	Marietta	Ohio
17	Wright-Patterson Air Force Base	Dayton	Ohio
18	Yeoman Creek Landfill	Waukegan	Illinois